Pseudodiffusive magnetotransport in bilayer graphene Corbino disks

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Abstract

We present a theoretical study of the pseudodiffusive transport and magnetoconductance of bilayer graphene (BLG) in the Corbino geometry. Using the Landauer-Büttiker formalism together with the transfer matrix approach in the angular momentum space, we investigate the impact of the trigonal warping on the magnetotrasport as well as the scaling properties of ballistic bilayer graphene Corbino disks [1].

The conductivity at the charge-neutrality point and zero magnetic field exhibits a one-parameter scaling (see Fig. 1) [1,2]. Although the considered system is ballistic and interactions are not taken into account, the scaling flow reproduces the behavior expected from disordered systems of Dirac fermions with Coulomb repulsion [3].

Weak magnetic fields enhance the conductivity, which can reach its maximal value near the crossover field B_L proportional to the next nearest-neighbor intervalley hopping integral t'. For magnetic fields $B \gtrsim B_L$ the average magnetoconductivity asymptotically drops with increasing magnetic field as B^{-1}, approaching the pseudodiffusive value $\sigma=8e^2/h$ [1,4].

In strong magnetic fields, the conductivity, as well as higher charge-transfer cumulants, show beating patterns with an envelope period proportional to $(B/B_L)^{1/2}$ (see Fig. 2). This provides a qualitative difference between the high-field ($B \gg B_L$) magnetotransport in the t' = 0 and in the t' ≠ 0 case [1], providing a finite-system analog of the Lifshitz transition.

References

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Figures

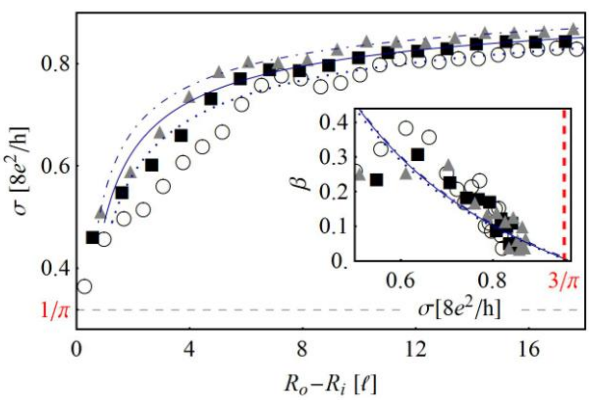

Figure 1. Minimal conductivity of an unbiased BLG Corbino disk with inner radii R_i, the radii ratio R_o/R_i = 2, and different values of t'. The triangles, squares and circles represent the data obtained numerically for t'=0.3 eV, t'= 0.2 eV, and t'= 0.1 eV (respectively), with the lines (dot-dashed, solid and dotted) depicting the asymptotic behavior. The inset presents the scaling function β(σ)=dlog(σ)/dlog(L) with L= R_o-R_i being the system size (units *l* depend on *t'*).

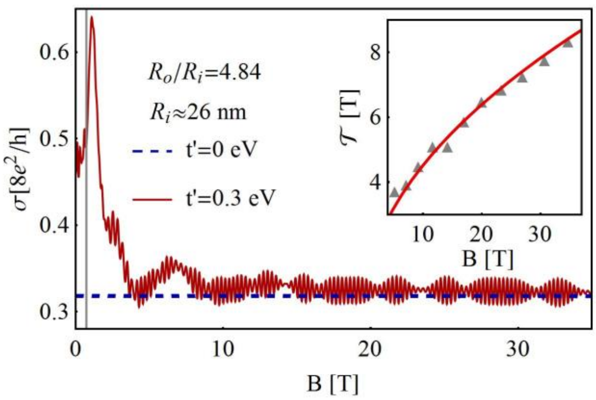

Figure 2. Conductivity of BLG disk with inner radii R_i≈26 nm, the radii ratio R_o/R_i = 4.84 for t'=0 eV (dashed blue line) and t'=0.3 eV (solid red line). The vertical grey line marks the value of B_L. The inset presents the period T of the beating envelope. The solid line corresponds to an approximate dependence on B proportional to $(B/B_L)^{1/2}$.